

# MONITORING REPORT

## 50 MW SIPANSIHAPORAS HYDRO POWER PLANT NORTH SUMATRA



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Contact Information:

|                          |                                                                                                                                                                                                               |
|--------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Project Title</b>     | 50 MW Sipansihaporas Hydro Power Plant, North Sumatra                                                                                                                                                         |
| <b>Version</b>           | 2.0                                                                                                                                                                                                           |
| <b>Report ID</b>         | <b>SIPAN VCS #2</b>                                                                                                                                                                                           |
| <b>Date of Issue</b>     | 5-August-2013                                                                                                                                                                                                 |
| <b>Project ID</b>        | VCS Database Project ID 486                                                                                                                                                                                   |
| <b>Monitoring Period</b> | 01-April-2010 to 28-February-2013 (both days included)                                                                                                                                                        |
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## 1 PROJECT DETAILS

### 1.1 Summary Description of Project

The 50 MW Sipansihaporas Hydro Power Plant, North Sumatra (hereinafter refer to project activity) is a new run-of-river type hydro power plant. Total installed capacity of the project is 50 MW, comprised of a 33 MW and 17 MW turbines. Stringing a circuit of the existing 150 kV single circuit transmission lines, which is being operated from Sibolga substations, connects the project to the grid. The length of the new lines from each power station to the substation is 7.8 km and 0.9 km respectively. Below is the technical description of the turbines:

| No | Description  | SIPAN 1                | SIPAN 2                |
|----|--------------|------------------------|------------------------|
| 1  | Brand        | Toshiba                | Toshiba                |
| 2  | Model        | Francis vertical shaft | Francis vertical shaft |
| 3  | Serial No    | M211071 CR1101         | M211071 CR2101         |
| 4  | Rated Head   | 128.4 m                | 67 m                   |
| 5  | Rated Output | 33 MW                  | 17 MW                  |
| 6  | Rated Speed  | 429 rpm                | 375 rpm                |

The project is owned and developed by PT. PLN (Persero), a state-owned electricity company. The project supplies electricity to the connected Sumatra grid.

The Sipansihaporas Hydroelectric project was registered as VCS project with Project ID 486. Further background on this project can be found in the Voluntary Carbon Standard Project Description (VCS PD).

Prior to the implementation of the project activity there is no existing power generation at the project location, electricity in grid is generated mainly from fossil fuel sources and is solely distributed to consumers via the electricity grid.

According to the VCS-PD, the project emission of the project activity is measured from diesel fuel quantity in diesel genset operational data logbook. PP has proposed 'Deviation in Monitoring Plan' to change source of data for the  $FC_{i,y}$  parameter (detail on section 2.2 'Project Description Deviations' and section 3.3.3. ad II 'Total diesel oil consumption, from the operational of DG Set'). The emissions reduction of the project for crediting period 01 April 2010 – 28 February 2013 is 392,884 t CO<sub>2</sub>.

| Vintage Year                    | Emissions Reduction | Unit               |
|---------------------------------|---------------------|--------------------|
| 1 April 2010 – 31 December 2010 | 92,401              | tCO <sub>2</sub> e |

|                                        |                |                         |
|----------------------------------------|----------------|-------------------------|
| 1 January 2011 – 31 December 2011      | 131,917        | tCO <sub>2</sub> e      |
| 1 January 2012 – 31 December 2012      | 140,498        | tCO <sub>2</sub> e      |
| 1 January 2013 – 28 February 2013      | 28,068         | tCO <sub>2</sub> e      |
| Total 01 April 2010 – 28 February 2013 | <b>392,884</b> | <b>tCO<sub>2</sub>e</b> |

## 1.2 Sectoral Scope and Project Type

Sectoral scope : 01. Energy industries (renewable - /non-renewable sources)

Project Type : I. Renewable energy project

Project Category : Grid connected electricity generation from renewable sources

## 1.3 Project Proponent

**PT. PLN (Persero)** – the project owner of '50 MW Sipansihaporas Hydro Power Plant, North Sumatra'

|                  |                                                                            |
|------------------|----------------------------------------------------------------------------|
| Address:         | Jl. Trunojoyo blok M 1/135, Kebayoran Baru<br>Jakarta – 12160<br>Indonesia |
| Telephone:       | +62-21-725 1234                                                            |
| Fax:             | +62 21 722 7026                                                            |
| URL:             | <a href="http://www.pln.co.id">www.pln.co.id</a>                           |
| Represented by:  | Mr. I Made Ro Sakya                                                        |
| Mobile:          | +62-811-960 705                                                            |
| Direct Fax:      | +62 21 739 7359                                                            |
| Direct Tel:      | +62-21 726 1122 ext. 1112                                                  |
| Personal E-Mail: | <a href="mailto:assistias@pln.co.id">assistias@pln.co.id</a>               |

**South Pole Carbon Asset Management Ltd.,** - the VER Consultant and Buyer of project activity

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 Telephone : + 41 43 501 3550  
 Represented by : Mr. Renat Heuberger  
 Email : [registration@southpolecarbon.com](mailto:registration@southpolecarbon.com)

## 1.4 Other Entities Involved in the Project

Not applicable since no other project participant involved in the project beside South Pole Carbon Asset Management Ltd and PT. PLN (Persero).

## 1.5 Project Start Date

As per the VCS policy announcement from the 10 September 2008, the project start date is the date on which the project activity began reducing or removing GHG emissions.

Following are the two units' commissioning date:

- Sipansihaporas Hydro Power Plant Unit 1: 14 December 2004 (Certificate for Proper Operation or *Sertifikat Laik Operasi*)
- Sipansihaporas Hydro Power Plant Unit 2: 21 October 2002 (Certificate for Proper Operation or *Sertifikat Laik Operasi*)

Thus, the project start date is when project activity starts reducing emissions is 21 October 2002, as the earliest project start date of two units at Sipansihaporas Hydro Power Plant.

## 1.6 Project Crediting Period

- HEPP Project starting date : 21 October 2002
- VCS Crediting period start date : 01 April 2006
- VCS crediting period : 10 years (01-Apr-2006 until 31-Mar-2016)

## 1.7 Project Location

The project area of the Sipansihaporas Hydropower Plant is situated in North Sumatra Province at about 344 km south of Medan city as the capital city of North Sumatra province and 12 km east of Sibolga as the capital city of Tapanuli Tengah district. The principal structures of the Sipansihaporas project such as the main dam and waterway are situated in the downstream of the confluence of the three tributaries upstream of the Sipansihaporas River, which are Sarumanggita river, Natolbak river and Barget river. The water flows from Sipansihaporas River

with total catchment area of 196 km<sup>2</sup> for power station no. 1, and 210 km<sup>2</sup> for power station no. 2, with a yearly average flow of 28,5 m<sup>3</sup>/sec.

The exact location to Sipansihaporas Hydropower Plant :

| Power Station                   | North Latitude | East Longitude |
|---------------------------------|----------------|----------------|
| Sipansihaporas #1 power station | 1.74058 N      | 98.86711 E     |
| Sipansihaporas #2 power station | 1.72882 N      | 98.84018 E     |

The location of the project site is shown in the following maps:



Figure 1 - Location of Sipansihaporas Hydroelectric Power Plant

## 1.8 Title and Reference of Methodology

Approved consolidated baseline methodology ACM0002 - Consolidated baseline methodology for grid-connected electricity generation from renewable sources, Version 10 (EB 47 annex 7).

Sectoral scope 01 - Energy Industries (renewable-/non-renewable sources).

## 2 IMPLEMENTATION STATUS

### 2.1 Implementation Status of the Project Activity

- From the validated VCS PD Version 3, dated 06 November 2009, it is known that with installed capacity of 50 MW, the power plant has the potential to generate power about 214,800 MWh per year, estimated. During this monitoring period, the project activity has generated power of 528,824 MWh with details as below:

- 01 April – 31 December 2010 : 124,369 MWh
- 01 January – 31 December 2011 : 177,569 MWh
- 01 January – 31 December 2012 : 189,113 MWh
- 01 January – 28 February 2013 : 37,778 MWh

Sipansihaporas Hydro Power Plant Unit 1 was commissioned on 14 December 2004 and Sipansihaporas Hydro Power Plant Unit 2 was commissioned on 21 October 2002.

## 2.2 Project Description Deviations

### A. Deviation to parameter $FC_{PJ,y}$

As per validated VCS PD, PP must monitor parameter  $FC_{PJ,y}$  as described in the latest version of the “Tool to calculate project or leakage CO<sub>2</sub> emissions from fossil fuel combustion” (Version 02, 2nd August 2008, EB 41).

| Subject                                                          | Original Monitoring Plan as per validated VCS PD                                                                                                                                                                                                                                                                                                                                            | Deviation of the Monitoring Plan                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description of measurement methods and procedures to be applied: | <p>Fuel consumption will be recorded monthly, specifically for each fuel (currently only diesel consumption is available).</p> <p>Fuel consumption will be calculated from static graduated level gauges on the fuel injection tanks by using emergency diesel genset, resulted in liters then converted to tonnes using fuel specific density or scientifically proven fuel densities.</p> | <p>Fuel consumption will be recorded monthly, specifically for each fuel (currently only diesel consumption is available).</p> <p>Fuel consumption will be calculated based on diesel oil purchase receipt.</p> <p>If the purchase receipt not available for particular month, the largest purchase amount during this monitoring period is taken for conservative estimation. Hence the project emission of <math>PE_y</math> is higher and this is conservative.</p> <p>Fuel consumption value in litres is converted to tonnage using fuel specific density or scientifically proven fuel densities.</p> |

### 2.3 Grouped Project

The specified project is not a part of a grouped project.

## 3 DATA AND PARAMETERS

### 3.1 Data and Parameters Available at Validation

|                        |                                                                                                                                                                                                                                                                                                                                                                                                                  |
|------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Data Unit / Parameter: | $EF_{grid,CM,y}$                                                                                                                                                                                                                                                                                                                                                                                                 |
| Data unit:             | tCO <sub>2</sub> /MWh                                                                                                                                                                                                                                                                                                                                                                                            |
| Description:           | Grid Emission Factor of Sumatra                                                                                                                                                                                                                                                                                                                                                                                  |
| Source of data:        | DNA of Indonesia<br><a href="http://pasarkarbon.dnpi.go.id/web/index.php/komnasmpr/read/14/faktor-emisi-jaringan-listrik-sumatera-dan-jamali-2008.html">http://pasarkarbon.dnpi.go.id/web/index.php/komnasmpr/read/14/faktor-emisi-jaringan-listrik-sumatera-dan-jamali-2008.html</a>                                                                                                                            |
| Value applied:         | 0.743                                                                                                                                                                                                                                                                                                                                                                                                            |
| Purpose of the data:   | The data is used for baseline emission calculation as per 'Tool to calculate the emission factor for an electricity system', Version 01.1 29 July 2008 (EB 35, Annex 12).                                                                                                                                                                                                                                        |
| Any comment:           | The 2008 grid emission factor has been crosschecked with the 2006 value, which was with 0.855 tCO <sub>2</sub> /MWh significantly higher and therefore less conservative. Hence, following the tool by using the most current data available at submission to validation and in terms of conservativeness the emission factor of 2008 is the appropriate value to be used in the emission reduction calculation. |

|                        |                                                                                                                                                                                                               |
|------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Data Unit / Parameter: | $NCV_{i,y}$                                                                                                                                                                                                   |
| Data unit:             | TJ / ton fuel                                                                                                                                                                                                 |
| Description:           | Net calorific value of diesel fuel                                                                                                                                                                            |
| Source of data:        | 2006 IPCC Guidelines for National Greenhouse Gas Inventories                                                                                                                                                  |
| Value applied:         | 0.043                                                                                                                                                                                                         |
| Purpose of the data:   | The data is used for project emission calculations as per approved methodology ACM0002, "Consolidated monitoring for zero-emissions grid-connected electricity generation from renewable sources", Version 10 |
| Any comment:           |                                                                                                                                                                                                               |

|                        |       |
|------------------------|-------|
| Data Unit / Parameter: | $P_i$ |
|------------------------|-------|

|                      |                                                                                                                                                                                                               |
|----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Data unit:           | kg/m <sup>3</sup>                                                                                                                                                                                             |
| Description:         | Density of diesel fuel                                                                                                                                                                                        |
| Source of data:      | Pertamina diesel fuel specification <sup>26</sup>                                                                                                                                                             |
| Value applied:       | 0.815 kg/liter = 815 kg/m <sup>3</sup>                                                                                                                                                                        |
| Purpose of the data: | The data is used for project emission calculations as per approved methodology ACM0002, "Consolidated monitoring for zero-emissions grid-connected electricity generation from renewable sources", Version 10 |
| Any comment:         |                                                                                                                                                                                                               |

|                        |                                                                                                                                                                     |
|------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Data Unit / Parameter: | <b>EF<sub>CO<sub>2</sub>,i,y</sub></b>                                                                                                                              |
| Data unit:             | tCO <sub>2</sub> /GJ                                                                                                                                                |
| Description:           | Weighted average CO <sub>2</sub> emission factor of diesel fuel in year 'y'                                                                                         |
| Source of data:        | IPCC default value is used (Source: 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Workbook volume 2 chapter 1 Table 1.4).                           |
| Value applied:         | 0.074                                                                                                                                                               |
| Purpose of the data:   | The data is used for project emission calculations as per 'Tool to calculate project or leakage CO <sub>2</sub> emissions from fossil fuel combustion' (version 02) |
| Any comment:           |                                                                                                                                                                     |

### 3.2 Data and Parameters Monitored

|                        |                                                                                                                                                                                                                                                                                    |
|------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Data Unit / Parameter: | <b>EG<sub>PJ,y</sub></b>                                                                                                                                                                                                                                                           |
| Data unit:             | kWh                                                                                                                                                                                                                                                                                |
| Description:           | Net electricity supplied to the grid by the project activity during the year y                                                                                                                                                                                                     |
| Source of data:        | kWh meter at project activity site (switchyard)<br><br>The electricity generation's data used for monitoring is the monthly electricity generation report delivered to grid signed by both parties of generation department and transmission department (Joint Meter Reading/JMR). |

<sup>26</sup> [http://www.pertamina.com/index.php?option=com\\_content&task=view&id=3262&Itemid=697](http://www.pertamina.com/index.php?option=com_content&task=view&id=3262&Itemid=697)

| Description of measurement methods and procedures to be applied: | <p>Electricity supplied to the grid measured by a watt-hour meter (connected to a digital control system and recorded continuously), which can measure export and import electricity data separately. Net electricity delivered to the grid is the difference of export and import electricity.</p> <p>The JMR form issued by the Sipansihaporas HEPP Generation Unit is the basis for calculation of the emission reductions. The joint meter reading taken at the transaction point is witnessed by the presence of P3B officials as transmission department and the PP representative as generation department.</p> <p>The accuracy class of main and back up meter is 0.2</p>                                            |               |       |                                                         |                                                                                          |        |                         |          |         |         |      |                                                         |                                                                                          |          |         |         |      |                                                         |                                                                                          |
|------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|-------|---------------------------------------------------------|------------------------------------------------------------------------------------------|--------|-------------------------|----------|---------|---------|------|---------------------------------------------------------|------------------------------------------------------------------------------------------|----------|---------|---------|------|---------------------------------------------------------|------------------------------------------------------------------------------------------|
| Frequency of monitoring/recording:                               | The measurement of electricity supplied to the grid conducted by joint meter reading taken at the transaction point on a regular basis (monthly), where monthly data is recorded and continuous total electricity measurement is available. The measurement results summarized in regular production reports.                                                                                                                                                                                                                                                                                                                                                                                                                |               |       |                                                         |                                                                                          |        |                         |          |         |         |      |                                                         |                                                                                          |          |         |         |      |                                                         |                                                                                          |
| Value monitored:                                                 | 528,824,000                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |               |       |                                                         |                                                                                          |        |                         |          |         |         |      |                                                         |                                                                                          |          |         |         |      |                                                         |                                                                                          |
| Monitoring equipment:                                            | <p>Type: Digital Watt-hour meter type ACTARIS SL7000 (Main Meter)</p> <p>Accuracy class: 0.2</p> <table><tr><th>Serial number</th><th>Type</th><th>Manufacture</th><th>Class</th><th>Remark</th><th>Calibrator<sup>1</sup></th></tr><tr><td>36027177</td><td>SL 7000</td><td>Actaris</td><td>0.2s</td><td>Code MU-1 to monitor the electricity supply from Unit 1</td><td>Laboratorium Kalibrasi - PT. PLN (Persero) Penelitian dan Pengembangan Ketenagalistrikan</td></tr><tr><td>36027137</td><td>SL 7000</td><td>Actaris</td><td>0.2s</td><td>Code MU-2 to monitor the electricity supply from Unit 2</td><td>Laboratorium Kalibrasi - PT. PLN (Persero) Penelitian dan Pengembangan Ketenagalistrikan</td></tr></table> | Serial number | Type  | Manufacture                                             | Class                                                                                    | Remark | Calibrator <sup>1</sup> | 36027177 | SL 7000 | Actaris | 0.2s | Code MU-1 to monitor the electricity supply from Unit 1 | Laboratorium Kalibrasi - PT. PLN (Persero) Penelitian dan Pengembangan Ketenagalistrikan | 36027137 | SL 7000 | Actaris | 0.2s | Code MU-2 to monitor the electricity supply from Unit 2 | Laboratorium Kalibrasi - PT. PLN (Persero) Penelitian dan Pengembangan Ketenagalistrikan |
| Serial number                                                    | Type                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Manufacture   | Class | Remark                                                  | Calibrator <sup>1</sup>                                                                  |        |                         |          |         |         |      |                                                         |                                                                                          |          |         |         |      |                                                         |                                                                                          |
| 36027177                                                         | SL 7000                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Actaris       | 0.2s  | Code MU-1 to monitor the electricity supply from Unit 1 | Laboratorium Kalibrasi - PT. PLN (Persero) Penelitian dan Pengembangan Ketenagalistrikan |        |                         |          |         |         |      |                                                         |                                                                                          |          |         |         |      |                                                         |                                                                                          |
| 36027137                                                         | SL 7000                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Actaris       | 0.2s  | Code MU-2 to monitor the electricity supply from Unit 2 | Laboratorium Kalibrasi - PT. PLN (Persero) Penelitian dan Pengembangan Ketenagalistrikan |        |                         |          |         |         |      |                                                         |                                                                                          |          |         |         |      |                                                         |                                                                                          |
| QA/QC procedures to be applied:                                  | <p>The QA/QC is conducted through crosschecking the sales electricity receipts (Monthly Electricity Protocol Report) at the transaction point with water tax payment receipts issued by North Sumatera Province Tax Office (local government).</p> <p><i>Note: During monitoring period of May – December 2011 where the water tax payment receipts were temporary not available during site visit verification, the main meter reading report (Monthly Electricity Protocol Report) at the transaction point is cross-checked with the Monthly Electricity Transfer Protocol Receipt issued by Pandan Sector Office as the electricity supply recipient.</i></p>                                                            |               |       |                                                         |                                                                                          |        |                         |          |         |         |      |                                                         |                                                                                          |          |         |         |      |                                                         |                                                                                          |

<sup>1</sup> Laboratorium Kalibrasi - PT. PLN (Persero) Penelitian dan Pengembangan Ketenagalistrikan (Calibration Laboratory - PT. PLN (Persero) Research and Development of Electricity) has been accredited by the National Accreditation Committee (Komite Akreditasi Nasional / KAN) with certificate number of LK-007-IDN for Laboratory of Calibration.

|                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|---------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                     | <p>Meters at generation unit is calibrated once every five-year according to the national regulation (refer to <a href="http://prokum.esdm.go.id/permen/2008/Permen%20ESDM%2037%202008.pdf">http://prokum.esdm.go.id/permen/2008/Permen%20ESDM%2037%202008.pdf</a>)</p> <p>The meter at the Generation Unit (Main meter at the transaction point) will be read regularly and jointly by the person in charge from Generation unit and Transmission unit.</p> <p>Note for Monitoring Frequency:</p> <p>Sipansihaporas HEPP has conducted periodic calibration round with details as below:</p> <p>The date of 1<sup>st</sup> calibration: 28 July 2005</p> <p>The date of 2<sup>nd</sup> calibration: 10 April 2010</p> |
| Calculation method: | Net electricity supplied to grid is calculated as the difference between $EG_{\text{export}}$ and $EG_{\text{import}}$ ( $=EG_{\text{export}} - EG_{\text{import}}$ ).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Any comment:        | n.a                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |

|                                                                  |                                                                                                                                                                                                                                                                                                                                                                          |
|------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Data Unit / Parameter:                                           | $FC_{i,y}$                                                                                                                                                                                                                                                                                                                                                               |
| Data unit:                                                       | Ton                                                                                                                                                                                                                                                                                                                                                                      |
| Description:                                                     | Amount of diesel fuel used in the hydropower plant operation during the year y.                                                                                                                                                                                                                                                                                          |
| Source of data:                                                  | Calculated – Project Owner – diesel fuel purchase receipt                                                                                                                                                                                                                                                                                                                |
| Description of measurement methods and procedures to be applied: | Fuel consumption is calculated from the monthly diesel oil purchase receipt, then converted to ton using fuel specific density or scientifically proven fuel densities.                                                                                                                                                                                                  |
| Frequency of monitoring/recording:                               | Fuel consumption recorded monthly, specifically for each fuel (currently only diesel consumption is available).                                                                                                                                                                                                                                                          |
| Value monitored:                                                 | 10.07 ton (12,360 liter)                                                                                                                                                                                                                                                                                                                                                 |
| Monitoring equipment:                                            | -                                                                                                                                                                                                                                                                                                                                                                        |
| QA/QC procedures to be applied:                                  | <p>No equipment is use to measure the actual diesel oil consumption. Fuel consumption calculated based on the diesel oil purchase receipt.</p> <p>Since the purchase receipt was not available for each particular month, the largest purchase amount during this monitoring period was taken for conservative estimation. Hence the above reported figure is higher</p> |

|                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|---------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                     | <p>than the actual fuel consumption data.</p> <p>Operator of Sipansihaporas HEPP recorded the diesel oil consumption assumption on the historical card, whenever they operate the DG set. The diesel oil purchase receipt will be crosschecked with this historical card.</p>                                                                                                                                                                                                            |
| Calculation method: | Converted from litre to ton using the density of diesel.                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Any comment:        | <p>The value applies for fuel consumption calculation taken from the diesel oil purchase receipt record from period 2010 – 2013.</p> <p>Fuel consumption will only occur in emergencies when power plant is not operational and the grid is also not available, a confluence of events which is expected to happen very rarely; at other times the plant will run on grid electricity. DG set usage is only for critical instrument/control system during turbine trip and shutdown.</p> |

### 3.3 Description of the Monitoring Plan

This section details the steps taken to monitor on a regular basis the GHG emissions reductions from the Sipansihaporas Hydroelectric Power Plant Project in Indonesia in accordance with ACM0002 version 10.

The Monitoring Plan for this project has been developed to ensure that the project collects and archives complete data from the very start.

#### 3.3.1 Monitoring period

The monitoring period covers 01 April 2010 to 28 February 2013 (both days included)

#### 3.3.2 Monitoring organization

The monitoring team has been established and integrated within the existing organization structure of Sipansihaporas hydropower plant prior to the start of the verification<sup>2</sup>. Clear roles and responsibilities are assigned to all staff involved in the VCS project and the prospect of

<sup>2</sup> the PLN Pandan Sector Office manages the Sipansihaporas HEPP Generation Unit. During the crediting period of 01 April 2010 – 31 Feb 2013 no specific VCS monitoring team has been established. Therefore, the existing organization structure of Sipansihaporas HEPP Generation Unit was assigned by PLN Pandan Sector Office to monitor the VCS project.

Subsequently, the PLN Pandan Sector has formed the VCS Monitoring Team (for both Sipansihaporas and Lau Renun VCS Project) through the 'Keputusan Manajer PT PLN (Persero) Sektor Pembangkitan Pandan Nomor : 067.K/MSPDN/2012' letter (or Management Decision Letter of PT PLN (Persero) Pandan Generation Sector Office No : 067.K/MSPDN/2012).

nominating a VCS Manager have been considered. The VCS Manager has the overall responsibility for the monitoring system on this project.

All other VCS monitoring staff will have clearly defined roles and responsibilities. The VCS manager will manage the process of training new staff; ensure trained staff performs the monitoring duties as necessary; and ensure that where trained monitoring staff is absent; the integrity of the monitoring system is maintained by other trained staff.

A formal set of monitoring procedures is established prior to the start of the verification. These procedures will detail the organization, control, and the steps required for certain key monitoring system features, including:

- a) VCS staff training
- b) VCS data and record keeping arrangements
- c) Data collection
- d) VCS data quality control and quality assurance
- e) Equipment maintenance
- f) Equipment calibration
- g) Equipment failure

The procedures agreed and signed off by PT PLN (Persero) and South Pole Carbon Asset Management Ltd. Any changes to procedures need to be agreed by both parties. The VCS manager responsible for ensuring that the procedures are followed on site and for continuously improving the procedures to ensure a reliable monitoring system is established.<sup>3</sup>

### **3.3.3 Monitoring equipment and installation**

Considering that the emission factor is calculated *ex-ante* and according to the Monitoring Methodology ACM0002 version 10, the only data to be monitored is electricity supplied to the grid by the project (detailed in section 3.2). The primary instruments include:

#### **Metering of Electricity Supplied to the Grid**

The main electricity meter for establishing the net electricity delivered to the grid (detailed in section 3.2) is installed at the Sipansihaporas 150 kV transmission line. This electricity meter will be the main meter (revenue meter), measuring the quantity of electricity supplied (net electricity delivered) to the grid. Net electricity delivered to the grid would be the difference of electricity export and import. As this meter provides the main VCS measurement, this is the key part of the verification process. The main meter is located at the Sipansihaporas power station. The main

<sup>3</sup> The Pandan Sector has implemented the key monitoring system as mentioned above by having the PLN monitoring system on their management system.

As part of the PLN management system requirement, Sipansihaporas HEPP has develop some SOPs as follow:

- SOP to read the Electricity Meter
- SOP to calibrate the Test and Measurement equipment.
- SOP to develop an Electricity Transfer Monthly Protocol Report (BAP)
- SOP for Electricity Transfer
- SOP for Emergency Response
- SOP for Line Charging

electricity meter reading record (Joint Meter Reading) then recorded on the Monthly Transfer Electricity Protocol Record (METPR) issued by Sipansihaporas HEPP Generation Unit.

The main electricity meter read together by representatives from PT PLN (Persero) Generation Division (PT PLN (Persero) Generation Unit Sipansihaporas HEPP) and PT PLN (Persero) Load Dispatcher and Transmission Division (PT PLN (Persero) Sibolga Sub-Station).

Electricity meters should meet the relevant local standards at the time of installation and calibrated by the manufacturer before installation. The meters installed by the project according to the Indonesian standard "Standard Electricity Meter Equipment". Records of the meter (type, make, model, and calibration documentation) retained in the quality control system on-site.

All equipment calibrated by the manufacturer according to relevant local standards at the time of installation and maintained in accordance with the manufacturer's recommendations to ensure accuracy of measurements. Records of the meter (type, make, model, calibration, and maintenance documentation) retained as part of the VCS monitoring system.

#### **Main Meter Quality Control**

The project developer owns the meter and is responsible for its maintenance and calibration, as stated in the SOPs. PLN Transmission Division and its representative are entitled to be present during any test, inspection, maintenance, and replacement of any part of the metering system, which will be performed by the meter manufacturer on request of the project developer.

The project developer specifies the QC (flow-chart) procedure for calibration of test and measurement equipment (SOP to calibrate the Test and Measurement equipment) to ensure the measurement accuracy of values shown by the instrument / measuring device and test or a measurement system (one of the instrument mentioned on this SOP is the electricity meter). The calibration can be done internally or externally depend on the type of measuring equipment and resource capability. The electricity meter, which located at the Sipansihaporas HEPP project site is calibrated by the external party.

The main meter is specified to have 0.2s class. The calibration of test and measurement equipment shall be conducted to ensure the measurement accuracy of the main meter. PT. PLN (Persero) Penelitian dan Pengembangan Ketenagalistrikan, National government approved laboratory certified 1702 and authorized by the Government of Indonesia, to conduct such calibration. Periodic calibrations are to be done at least once every five years as per applicable metering standard issued by the Minister of Energy and Mineral Resource of Republic of Indonesia.

#### **Main Electricity Meter specification:**

| Serial Number               | Type              | Factory | Class | Location                                                    |
|-----------------------------|-------------------|---------|-------|-------------------------------------------------------------|
| <b>MAIN METER (SIPAN 1)</b> |                   |         |       |                                                             |
| 36027177                    | SL 7000 (Digital) | Actaris | 0.2s  | Main electricity meter 1 (SIPAN 1) → to monitor electricity |

|                      |                      |         |      |                                                                                         |
|----------------------|----------------------|---------|------|-----------------------------------------------------------------------------------------|
|                      |                      |         |      | supply from turbine SIPAN 1                                                             |
| MAIN METER (SIPAN 2) |                      |         |      |                                                                                         |
| 36027137             | SL 7000<br>(Digital) | Actaris | 0.2s | Main electricity meter 2 (SIPAN 2) → to monitor electricity supply from turbine SIPAN 2 |

Picture of the main meter is shown below:



Figure 3 - Picture of main meter

The Power Plant Operator periodically check if all tools and equipment work in a good condition as per the SOP<sup>4</sup>. In the event of any broken security seal in the metering system; or when the system fails to register, or if the measurement result is found upon testing to vary more than the allowable error from the standard meter used in the test, then an adjustment shall be made correcting all measurements of energy made by the metering system, as described in the SOP.

**There was no metering devices breakdown or malfunction during the following monitoring period (01 April 2010 – 28 February 2013).** All the meters listed above have performed well. In case of failure of the main meter, production meter and own consumption meter (hereinafter refer as cross-check meters) located at generation site of each power generation unit will be read to measure the quantity of electricity exported from the project. The difference between electricity produced and consumed on-site shall be valid for claiming carbon credits. In the special case of total failure of all meters no credits will be claimed during such period.

#### **Data recording procedure**

The procedures for collecting the electricity meter data is outlined in the Standard Operating Procedure as explained below.

The procedures for collecting the electricity meter data will be outlined in the Standard Operating

<sup>4</sup> [http://kepuustakaan-presiden.pnri.go.id/uploaded\\_files/pdf/government\\_regulation/normal/UU\\_2\\_1981\\_soeharto.pdf](http://kepuustakaan-presiden.pnri.go.id/uploaded_files/pdf/government_regulation/normal/UU_2_1981_soeharto.pdf)

Procedure signed between the project owner and the Grid Operator (both are under PLN)<sup>5</sup>. All relevant data will be archived electronically and backed up regularly. Uncertainty will be considered to achieve conservative results. Moreover, it will be kept for the full crediting period, plus two years after the end of the crediting period or the last issuance of VCUs for this project activity (whichever occurs later). The Monitoring Plan would develop to ensure that the project has robust data collection, processing, and archiving procedures.

Procedure for Joint Meter Reading (JMR) as per 'Procedure to develop Monthly Electricity Protocol Report' in general view:

- Joint meter reading by operator from Generation Unit (Unit Pembangkitan / UP) and Transmission Service Unit (Unit Pelayanan Transmisi / UPT P3B) conducted on the first date of each month at 10 A.M
- Operating and maintenance supervisor (O & M supervisor) responsible for recording the amount of EG imported and exported by Generation unit as the result from kWh meter downloading.
- Operating and maintenance supervisor responsible for constructing the electricity generating protocol report, which includes calculation of net electricity delivered to PLN transmission unit. This report has to be reported and signed by Unit Manager, which will then be further reported to the Sector Manager. VCS manager will have the copy of such report and be notified as well. The Sector Manager and VCS Manager have been handled by the same person during this monitoring period.
- O & M supervisor with other authorized staff from Generation unit will extract the data by downloading via computer from the kWh electronic meter and then record it in the form of Monthly Electricity Protocol (MEP), which shall be signed by both Generating unit (PLN Sipansihaporas Generation Unit) and PT. PLN P3B (Tragi Sibolga / Sibolga Sub-station). The joint meter reading taken at the transaction point is witnessed by the presence of P3B officials as transmission department and the PP representative as generation department.
- The MEP will be then rechecked by authorized person from PT. P3B (UPT Pematang Siantar / Pematang Siantar Transmission Unit) and PT PLN Generation Sector Office (Pandan Sector Office).

After all such information is rechecked and agreed by all related parties, the MEP will be signed by all authorized parties from Generation unit and Transmission unit. The report will thus be sent to PLN Medan as headquarter for all power plant units in North Sumatra.

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<sup>5</sup> Sipansihaporas HEPP is following the "Prosedur Pembuatan BA Pengiriman Energi Listrik PLTA Sipansihaporas" or the 'Procedure to develop Sipansihaporas HEPP Monthly Electricity Protocol Report' as the detail procedure for Electricity Transfer to the Sumatera Grid. This procedure is a further development refer to the General Operational Procedure for PLN generation unit located in the North and South Sumatera, titled "Prosedur tetap transfer tenaga listrik antara PT PLN (Persero) Pembangkitan Sumbagut, PT PLN (Persero) Pembangkitan Sumbagsel dengan PT PLN (Persero) P3B Sumatera"

All relevant data will be archived electronically and backed up regularly. Uncertainty will be considered to achieve conservative results. Moreover, it will be kept for the full crediting period, plus two years after the end of the crediting period or the last issuance of VCUs for this project activity (whichever occurs later). The Monitoring Plan has been developed to ensure that the project has robust data collection, processing, and archiving procedures.

#### **Total diesel oil consumption, from the operational of DG Set**

The Project Emission resulted from the consumption of diesel oil for the operational of Emergency Diesel Generator Set (Emergency DG Set). No equipment available on the project activity site to measure the actual diesel oil consumption ( $FC_{i,y}$  monitoring parameter). Fuel consumption calculated based on the diesel oil purchase receipt. If the purchase receipt not available for particular month, the largest purchase amount during this monitoring period is taken for conservative estimation.

Operator of Sipansihaporas HEPP recorded the diesel oil consumption assumption on the historical card, whenever they operate the DG set. The diesel oil purchase receipt is crosschecked with this historical card.

#### **VCS data collection and record keeping arrangements**

Every month the Operation Supervisor from Sipansihaporas Generation Unit (member of VCS Team) and Transmission Sub-station read the meter together and record the data on their logsheet. Based on this reading, a monthly electricity generation report was signed by both the generation department (Sipansihaporas HEPP Generation Unit) and the transmission department (Tragi Sibolga).

At the end of each month the monitoring data needs to be filed electronically. The electronic files need to have CD back-up and/or print-out. All written documentation such as maps, drawings, the EIA and the Feasibility study, should be stored for the crediting period and two years afterwards, and be made available to the verifier so that the reliability of the information may be checked.

## **4 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS**

### **4.1 Baseline Emissions**

#### **4.1.1 Formula used for baseline emissions calculation**

The formula used for determination of the baseline emissions are described in section 4.3 of the registered VCS PD Ver. 3 dated 10th November 2009.

Baseline emissions are calculated as follows:

$$BE_y = EG_{PJ,y} \times EF_{grid,CM,y} \quad (1)$$

| Parameter               | Description                                                                                                                                                   | Unit                   | Value   | Source                                                     |
|-------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|---------|------------------------------------------------------------|
| BE <sub>y</sub>         | Baseline emission during the period April'10 – Feb '13                                                                                                        | tCO <sub>2</sub> /year | 392,916 | Equation (1)                                               |
| EG <sub>PJ,y</sub>      | Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the project activity in April'10 – Feb '13 | MWh/yr                 | 528,824 | Monthly Electricity Protocol Report                        |
| EF <sub>grid,CM,y</sub> | Combined margin CO <sub>2</sub> emission factor for grid connected power generation in year y                                                                 | tCO <sub>2</sub> /MWh  | 0.743   | Indonesian DNA published grid emission factor for Sumatra. |

#### 4.1.2. Baseline emissions calculation

| Vintage Year                 | EG Facility (MWh) | BE <sub>y</sub> (tCO <sub>2</sub> e) |
|------------------------------|-------------------|--------------------------------------|
| 1 January - 31 December 2010 | 124,369           | 92,406                               |
| 1 January - 31 December 2011 | 177,565           | 131,931                              |
| 1 January – 31 December 2012 | 189,113           | 140,511                              |
| 1 January – 28 February 2013 | 37,778            | 28,069                               |
| <b>TOTAL</b>                 | <b>528,824</b>    | <b>392,916</b>                       |

## 4.2 Project Emissions

### 4.2.1 Formula used for project emissions calculation

The formula used for determination of the baseline emissions are described in section 4.3 of registered VCS PD Ver. 3 dated 10<sup>th</sup> November 2009.

Project emissions are calculated as follows:

$$PE_y = PE_{FF,y} + PE_{GP,y} + PE_{HP,y} \quad (2)$$

| Parameter          | Description                                                                                                           | Unit                  | Value      | Source                                                                                       |
|--------------------|-----------------------------------------------------------------------------------------------------------------------|-----------------------|------------|----------------------------------------------------------------------------------------------|
| PE <sub>y</sub>    | Project emission in year y                                                                                            | tCO <sub>2</sub> e/yr | Calculated | Equation (2)                                                                                 |
| PE <sub>FF,y</sub> | Project emissions from fossil fuel consumption in year y                                                              | tCO <sub>2</sub> /yr  | Calculated | "Tool to calculate project or leakage CO <sub>2</sub> emissions from fossil fuel combustion" |
| PE <sub>GP,y</sub> | Project emissions from the operation of geothermal power plants due to the release of non-condensable gases in year y | tCO <sub>2</sub> /yr  | 0          | <i>Not applicable.</i><br><br>Project activity is not a geothermal powerplant.               |
| PE <sub>HP,y</sub> | Project emissions from water reservoirs                                                                               | tCO <sub>2</sub> /yr  | 0          | <i>Not applicable.</i><br><br>Sipansihaporas HEPP is a run-off river hydro powerplant.       |

$$PE_{FF,y} = PE_{FC,j,CO_2}$$

$$PE_{FC,j,CO_2} = \sum FC_{i,j,y} \times COEF_{i,y} \quad (3)$$

| Parameter              | Description                                                                      | Unit                | Value                                                                                                                                               | Source                                                                                                                            |
|------------------------|----------------------------------------------------------------------------------|---------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|
| PE <sub>FC,j,CO2</sub> | CO <sub>2</sub> emissions from fossil fuel combustion in process j during year y | tCO <sub>2</sub> /y | <b>32.10</b><br><br><i>Note :</i><br><br>5.09 (for year 2010)<br><br>13.24 (for year 2011)<br><br>13.37 (for year 2012)<br><br>0.39 (for year 2013) | Equation (3)                                                                                                                      |
| FC <sub>i,j,y</sub>    | Quantity of fuel type I combusted in process j during the year y                 | ton/y               | <b>10.027</b><br><br><i>Note :</i><br><br>1.60 (for year 2010)<br><br>4.16 (for                                                                     | Measured in litre than converted into ton with formula as below:<br><br>Fuel Consumption (litre) x Fuel Density ( 0.815 kg/litre) |

|                     |                                                                      |                       |                                                                          |                     |
|---------------------|----------------------------------------------------------------------|-----------------------|--------------------------------------------------------------------------|---------------------|
|                     |                                                                      |                       | year 2011)<br><br>4.20 (for<br>year 2012)<br><br>0.12 (for<br>year 2013) |                     |
| COEF <sub>i,y</sub> | CO <sub>2</sub> emission coefficient of fossil fuel type i in year y | tCO <sub>2</sub> /ton | 3.1863                                                                   | Equation (4)        |
| i                   | Fuel types combusted in process j during year y                      | -                     | i= Diesel oil                                                            | Sipansihaporas HEPP |

COEF<sub>i,y</sub> is calculated using option B. Option B calculates COEF<sub>i,y</sub> based on net calorific value and CO<sub>2</sub> emission factor of fuel type i, as follows:

$$\text{COEF}_{i,y} = \text{NCV}_{i,y} \times \text{EF}_{\text{CO}_2,i} \quad (4)$$

| Parameter           | Description                                                               | Unit                        | Value              | Source                           |
|---------------------|---------------------------------------------------------------------------|-----------------------------|--------------------|----------------------------------|
| COEF <sub>i,y</sub> | CO <sub>2</sub> emission coefficient of fossil fuel type i in year y      | tCO <sub>2</sub> / ton fuel | 3.1863             | Equation (4)                     |
| NCV <sub>i,y</sub>  | Weighted average net calorific value of fuel type i in year               | TJ/ton fuel                 | Diesel Fuel: 0.043 | IPCC 2006 default for diesel oil |
| EF <sub>CO2,i</sub> | Weighted average CO <sub>2</sub> emission factor of fuel type i in year y | tCO <sub>2</sub> /TJ        | Diesel Fuel: 74.1  | IPCC 2006 default for diesel oil |
| i                   | Fuel types combusted in process j during year y                           | -                           | i=Diesel oil       | Sipansihaporas HEPP              |

#### 4.2.2 Project emissions from the consumption of fossil fuels

| Year             | Fuel Consumption<br>(ton) | PEy<br>(tCO <sub>2</sub> /year) |
|------------------|---------------------------|---------------------------------|
| 2010 (Apr – Dec) | 1.60                      | 5.09                            |
| 2011 (Jan – Dec) | 4.16                      | 13.24                           |

|                                   |              |              |
|-----------------------------------|--------------|--------------|
| 2012 (Jan – Dec)                  | 4.20         | 13.37        |
| 2013 (Jan – Feb)                  | 0.12         | 0.39         |
| Total 01 April 2010 – 28 Feb 2013 | <b>10.07</b> | <b>32.10</b> |

### 4.3 Leakage

No leakage emissions are considered. The main emissions potentially giving rise to leakage in the context of electric sector projects are emissions arising due to activities such as power plant construction and upstream emissions from fossil fuel use (e.g. extraction, processing, transport). These emissions sources are neglected.

$$LE_y = 0$$

### 4.4 Summary of GHG Emission Reductions and Removals

#### 4.4.1 Formula used for emission reductions calculation

Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y \quad (5)$$

| Parameter | Description                        | Unit               | Value      | Source       |
|-----------|------------------------------------|--------------------|------------|--------------|
| $BE_y$    | Baseline emissions in the period y | tCO <sub>2</sub> e | Calculated | Equation (1) |
| $PE_y$    | Project emissions in the period y  | tCO <sub>2</sub> e | Calculated | Equation (2) |
| $ER_y$    | Project emission in the period y   | tCO <sub>2</sub> e | Calculated | Equation (3) |

#### 4.4.2 The Emission Reduction calculation

| YEAR                        | $BE_y$ (in tCO <sub>2</sub> e) | $PE_y$ (in tCO <sub>2</sub> e) | $ER_y$ (in tCO <sub>2</sub> e) |
|-----------------------------|--------------------------------|--------------------------------|--------------------------------|
| 01 April – 31 December 2010 | 92,406                         | 5.09                           | 92,401                         |
| 01 January – 31 December    | 131,931                        | 13.24                          | 131,917                        |

|                               |                |              |                |
|-------------------------------|----------------|--------------|----------------|
| 2011                          |                |              |                |
| 01 January – 31 December 2012 | 140,511        | 13.37        | 140,498        |
| 01 January – 28 February 2013 | 28,069         | 0.39         | 28,068         |
| Total ERy 2010 - 2013         | <b>392,916</b> | <b>32.10</b> | <b>392,884</b> |

## 5 ADDITIONAL INFORMATION

### A. Comparison of actual emission reductions with estimates in registered VCS PD

| Item                                           | Values estimated in ex-ante calculation of registered VCS PD | Actual values achieved during this monitoring period |
|------------------------------------------------|--------------------------------------------------------------|------------------------------------------------------|
| <b>Emission reductions (t CO<sub>2</sub>e)</b> | 465,488                                                      | 392,884                                              |

Note : The total actual monitored months for this crediting period are 35 months.